



SM – 348

II Semester B.Sc. Examination, May/June 2018  
(Repeaters)  
(CBCS-14 – 15 & Onwards/ NS-2011 – 2012 & Onwards)  
PHYSICS – II

Thermal Physics and Statistical Mechanics

Time : 3 Hours

Max. Marks : 70

**Instruction :** Answer **any five** questions from **each** Part.

PART – A

Answer **any five** of the following questions. **Each** question carries **eight** marks.

(5×8=40)

1. a) Mention any two postulates of the kinetic theory of gases.  
b) Derive the equation  $PV = \frac{1}{3} mnc^2$  for an ideal gas enclosed in a cubical vessel on the basis of kinetic theory. (2+6)
2. Describe Andrew's experiment on carbondioxide and discuss the results of the experiment. 8
3. a) State and explain the first law of thermodynamics. Apply it to an adiabatic process.  
b) What is an isothermal process ? Derive an expression for work done in an isothermal process for an ideal gas. (3+5)
4. Explain the working of Carnot's ideal heat engine. Derive an expression for its efficiency in terms of the temperatures of the source and sink. 8
5. a) Write expressions for enthalpy and Gibb's free energy.  
b) Write the four Maxwell's thermodynamic relations. Hence deduce the expression for the difference in molar specific heats for an ideal gas. (2+6)
6. a) Define triple point of water.  
b) Derive Clausius – Clapeyron latent heat equation. (2+6)

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7. a) Describe Joule – Thomson porous plug experiment and discuss the results.  
 b) Give any two differences between Joule Thomson expansion and adiabatic expansion. (6+2)
8. a) State and explain Kirchoff's law of radiation.  
 b) Define solar constant. Explain the method to determine solar constant using Angstrom's pyreheliometer. (2+6)

## PART - B

Solve **any five** of the following problems. **Each** problem carries **four** marks. (5×4=20)

9. Calculate the mean free path of gas molecules of diameter  $3.07 \times 10^{-10}$  m given that the gas has  $2.7 \times 10^{25}$  molecules per  $\text{m}^3$ .
10. The mean speed of gas molecules is  $450 \text{ ms}^{-1}$ . The density of the gas is  $1.2 \text{ kgm}^{-3}$  and the mean free path of the gas molecules is  $9 \times 10^{-8}$  m. Calculate the coefficient of viscosity of the gas.
11. A definite mass of a perfect gas is compressed adiabatically to half its original volume. Determine the final pressure of the gas if its initial pressure was  $10^5 \text{ Nm}^{-2}$ .
12. What is the change in entropy of 0.2 kg of a block of copper when its temperature is increased from 283 K to 293 K? (Given specific heat of copper is  $388 \text{ Jkg}^{-1} \text{ K}^{-1}$ ).
13. Calculate the depression in melting point of ice for an increase of pressure of  $2 \times 10^5 \text{ Nm}^{-2}$ .  
 Given : Normal melting point of ice is = 273 K.  
 Specific volume of ice =  $1.091 \times 10^{-3} \text{ m}^3 \text{ kg}^{-1}$ .  
 Specific volume of water =  $1 \times 10^{-3} \text{ m}^3 \text{ kg}^{-1}$ .  
 Latent heat of ice =  $3.36 \times 10^5 \text{ Jkg}^{-1}$ .
14. Calculate the percentage error made in finding  $\log_e 5$  ! using Stirling's formula.



15. Van derWaal constants for helium gas are

$$a = 3.41 \times 10^{-3} \text{ Nm}^4 \text{ mol}^{-2} \text{ and}$$

$$b = 2.37 \times 10^{-5} \text{ m}^3 \text{ mol}^{-1}$$

$$\text{of } R = 8.31 \text{ Jmol}^{-1} \text{ K}^{-1}$$

Calculate the inversion temperature of helium.

16. A black body at 1500 K emits maximum energy of wavelength 2000 nm. What is the temperature of another black body which emits maximum energy of wavelength 550 nm ?

PART - C

Answer **any five** of the following. **Each** question carries **two** marks. (5×2=10)

- 17. a) Does the value of mean free path depend on the size of the gas molecules ? Explain.
- b) What is transferred from one layer to another layer in the phenomenon of thermal conductivity ?
- c) Does adiabatic expansion produce cooling effect ? Explain.
- d) A solid is an example of low entropy system. Explain.
- e) Helmholtz free energy is called thermodynamic potential at constant volume. Why ?
- f) What happens to the boiling point of water with increase in pressure ? Why ?
- g) Does an ideal gas show Joule Thomson effect ? Why ?
- h) White clothes are preferred in summer. Why ?

